

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. § 371**

Attorney Docket No.
M109.12-0001

U.S. Application No.
10/088007

INTERNATIONAL APPLICATION
PCT/FR 00/02493

INTERNATIONAL FILING DATE
8 September 2000 ✓

PRIORITY DATE CLAIMED
8 September 1999

TITLE OF INVENTION

FILTRATION METHOD AND FILTER CONSISTING OF NITROGEN-CONTAINING CYCLES OR HETEROCYCLES SUCH AS DNA OR RNA NOTABLY FOR
FILTERING TOBACCO SMOKE AND A CIGARETTE INCLUDING SUCH A FILTER

APPLICANT(S) FOR DO/EO/US
MAILLARD, Frederic et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f). The submission must include items (5), (6), (9) and (20) indicated below.
4. ☒ The US has been elected by the expiration of the 19th month from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
 - c. ☐ is not required, as the application was filed in English
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are attached hereto (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendment to the claims under PCT Article 19 (35 U.S.C. 372(c)(3)).
9. ☒ An unexecuted oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 37(c)(5)).

Items 11. to 17. Below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and .198.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
14. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
18. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
19. ☒ Other items or information:
 - a. ☒ One (1) sheet of drawings.
 - b. ☒ Abstract typed on a separate page.
 - c. ☒ File data sheet.

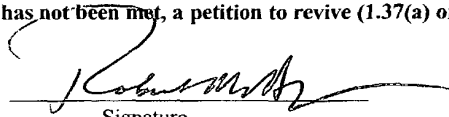
U.S. APPLICATION NO. 10/088007		INTERNATIONAL APPLICATION NO. PCT/FR00/02493		ATTORNEY'S DOCKET NUMBER M109.12-0001	
20. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492(A)(1)-(5)): Search Report has been prepared by the EPO or JPO.....\$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482)\$690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)).....\$710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....\$1000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)..... \$ 100.00				CALCULATIONS PTO USE ONLY	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$860	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$0	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	25- 20 =	5	X 18	\$90	
Independent claims	3- 3 =	0	X 80	\$0	
MULTIPLE DEPENDENT CLAIM (S) (if applicable)			+ \$270.00	\$0	
TOTAL OF ABOVE CALCULATIONS =				\$950	
<input checked="" type="checkbox"/> Applicant claims small entity status See 37 CFR 1.27 The fees indicated above are reduced by 1/2.				\$475	
SUBTOTAL =				\$475	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f))				\$0	
TOTAL NATIONAL FEE =				\$475	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property.				\$0	
TOTAL FEES ENCLOSED =				\$475	
				Amount to be:	
				refunded \$	
				charged \$	

- a. ☒ A check in the amount of \$475.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. **23-1123** in the amount of \$ to cover the above fees.
A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment, to Deposit Account No. **23-1123**. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 C.F.R. 1.494 or 1.495 has not been met, a petition to revive (1.37(a) or (b)) must be filed and granted to restore the application to pending status.

Send all correspondence to:

Robert M. Angus
 WESTMAN, CHAMPLIN & KELLY, P.A.
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 900 Second Avenue South
 Minneapolis, MN 55402-3319


 Signature
 Robert M. Angus
 Reg. No. 24,383

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named
Inventor : Frederic Maillard et al.

Appln. No.:

Filed : HEREWITH

For : FILTRATION METHOD AND FILTER
CONSISTING OF NITROGEN-
CONTAINING CYCLES OR
HETEROCYCLES SUCH AS DNA OR
RNA NOTABLY FOR FILTERING
TOBACCO SMOKE AND A CIGARETTE
INCLUDING SUCH A FILTER

Docket No.: M109.12-0001

Group Art Unit:
Examiner:

PRELIMINARY AMENDMENT

EXPRESS MAIL NO. EV049901155US
DATE OF DEPOSIT: March 12, 2002

Commissioner for Patents
Washington, D.C. 20231
Sir:

Prior to the calculation of fees, please
amend the above-identified application as follows:

IN THE SPECIFICATION

On Page 1, before line 1 and after the title,
please insert the following:

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a Section 371 national stage
application of International Application No.
PCT/FR00/02493, filed September 8, 2000, published March
22, 2001 as WO01/19210 not in English.

FIELD OF THE INVENTION

On Page 1, between lines 6 and 7, please insert
the following:

BACKGROUND OF THE INVENTION

On Page 2, between lines 11 and 12, please insert the following:

SUMMARY OF THE INVENTION

On Page 7, between lines 22 and 23, please insert the following:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates an exemplary molecule according to the present invention.

FIG. 2 illustrates a tobacco product, more particularly a cigarette, employing a filter according to an embodiment of the present invention.

DETAILED DESCRIPTIONIN THE CLAIMS

Please cancel claims 19 and 22-23.

Please amend claims 1-18 and 20-21 as follows:

1. (Amended) A selective, direct chemical, anti-carcinogenic action filtration method for filtering toxic products, in particular polycyclic aromatic hydrocarbons (PAH) such as benzo(a)pyrene (BaP) and nitrosamines, contained in the tobacco smoke of a tobacco product to control the level of toxic products as compared with that of nicotine in order that the level reduction at the output of the filter is larger than a predetermined threshold, the method comprising steps of:

scavenging all or part of the toxic products by means of an active ingredient acting on said toxic

products according to molecular processes comparable to those according to which DNA and/or RNA of the human cell react with regards to said toxic products,

controlling the operating conditions of the filter by operating in a substantially non-aqueous medium and with a basic pH, and

adjusting the mass of the active ingredient so that it is larger than or equal to 0.1% of the mass of the filter.

2. (Amended) The method according to claim 1, such that said active ingredient consists of molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles; said active ingredient is a chain of said molecules, or said molecules bound in a common chemical arrangement to one fiber, or both.

3. (Amended) The method according to claim 2, such that the molecule of the active ingredient is selected from the group consisting of DNA, RNA and derivatives thereof.

4. (Amended) A filter for a tobacco product with a selective, direct chemical, anti-carcinogenic action, for filtering polycyclic aromatic hydrocarbons (PAH), notably benzo(a)pyrene (BaP), as well as nitrosamines, while preserving the nicotine level and taste aromas for the satisfaction and the pleasure of the smoker;

said nitrogen-containing cycles or heterocycles operating in a substantially non-aqueous medium and with a basic pH.

9. (Amended) The filter according to claim 4, such that the pH of the filter is larger than 8.

10. (Amended) The filter according to claim 4, such that the molecule of the active ingredient is selected from the group consisting of DNA, RNA and derivatives thereof.

11. (Amended) The filter according to claim 4, such that at least one function is added to the molecule of the active ingredient, on at least one of the nitrogen-containing cycles or nitrogen-containing heterocycles, the function being selected from the group consisting of amine NH_2 , ketone, aldehyde, methyl, alkene, alkyl, and aryl.

12. (Amended) The filter according to claim 4, such that one or more sugars is added to at least one molecule of the active ingredient.

13. (Amended) The filter according to claim 4, such that one or more acid functions and at least a trivalent phosphorus atom are added to at least one molecule of the active ingredient.

14. (Amended) The filter according to any of claim 4, such that polymerization is performed at the nitrogen-containing cycles.

15. (Amended) The filter according to claim 4, such that the molecule of the active ingredient includes a halogen in a form of one or more atoms, molecules, radicals, or ions.

16. (Amended) The filter according to claim 4, such that the molecule of the active ingredient includes a sodium fluoride (NaF) salt medium.

17. (Amended) The filter according to claim 4, such that said fibers are partly halogenated, and/or are in a medium including atoms, molecules, radicals or ions of a halogen.

18. (Amended) A method for manufacturing a filter including an active ingredient consisting of molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles, said active ingredient being selected from the group consisting of a chain of said molecules and said molecules bound to a fiber in a common chemical arrangement; the mass of said nitrogen-containing cycles or heterocycles being at least equal to or larger than 0.1% of the total mass of the filter; said nitrogen-containing cycles or heterocycles operating in a substantially non-aqueous medium and with a basic pH, said method comprising the step of

extruding and/or rolling together said molecules and said fibers.

Claim 19 is cancelled.

20. (Amended) The filter according to claim 4, such that said molecules and/or said fibers are incorporated in separate compartments.

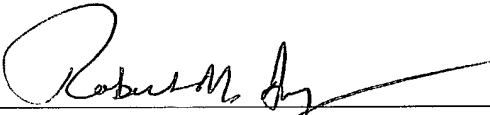
REMARKS

Favorable action is respectfully requested.

The Director is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 23-1123.

Respectfully submitted,

WESTMAN, CHAMPLIN & KELLY, P.A.

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RMA:tas

MARKED-UP VERSION OF REPLACEMENT CLAIMS

1. (Amended) A selective, direct chemical, anti-carcinogenic action filtration method for filtering toxic products, in particular polycyclic aromatic hydrocarbons (PAH) such as benzo(a)pyrene (BaP) and nitrosamines, contained in the tobacco smoke of a tobacco product ~~toeigarette~~; ~~said method comprising the step for~~ controlling the level of toxic products as compared with that of nicotine in order that the level reduction at the output of the filter is larger than a predetermined threshold, the method comprising steps of:

~~— (so that nicotine and taste aromas are preserved for the satisfaction and pleasure of smokers);~~

~~— in order to control the toxic product level as compared with that of nicotine, notably the level of polycyclic aromatic hydrocarbons (PAH) and nitrosamines, said method comprises the following steps:~~

~~— the step for~~

~~_____ scavenging all or part of the toxic products by means of an active ingredient acting on said toxic products according to molecular processes comparable to those according to which DNA and/or RNA of the human cell react with regards to said toxic products,~~

~~— the step for controlling the operating conditions of the filter by operating in a substantially non-aqueous medium and with a basic pH, preferably larger than or equal to 8, and~~

~~the step for adjusting the mass of the active ingredient so that it is larger than or equal to 0.1% of the mass of the cigarette filter and preferably larger than or equal to 1% of the mass of the filter.~~

2. (Amended) The method according to claim 1, such that said active ingredient consists of molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles ~~and particularly nitrogen-containing heteroaromatic cycles, notably pentacycles or hexacycles or a combination of both;~~ said active ingredient existing as:

~~is a chain of said molecules, or and/or~~

~~said molecules bound in a common chemical arrangement to one fiber, or both, notably a fiber consisting of cellulose acetate.~~

3. (Amended) The method according to claim 2, such that the molecule of the active ingredient is selected from the group consisting of DNA, and/or RNA and/or a DNA or RNA derivatives thereof, such as for example adenosine triphosphate (ATP), cyclic adenosine monophosphate (AMP), adenylecyclase.

4. (Amended) A cigarette filter for a tobacco product with a selective, direct chemical, anti-carcinogenic action, particularly ~~for filtering polycyclic aromatic hydrocarbons (PAH), notably benzo(a)pyrene (BaP), as well as nitrosamines, while preserving the nicotine level and taste aromas for the satisfaction and the pleasure of the smoker;~~

said filter including an active ingredient consisting of molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles, and ~~in particular nitrogen-containing heteroaromatic cycles, notably pentacycles or hexacycles or a combination of both,~~

 said active ingredient ~~existing as:~~ is
~~-----~~ a chain of said molecules, or and/or
~~-----~~ said molecules bound to a fiber in a common chemical arrangement, or both, ~~notably a fiber consisting of cellulose acetate;~~

the mass of said nitrogen-containing cycles or heterocycles ~~and particularly nitrogen-containing heteroaromatic cycles~~ being at least equal to or larger than 0.1% of the total mass of the filter; and

said nitrogen-containing cycles or heterocycles ~~and particularly nitrogen-containing heteroaromatic cycles~~ operating in a substantially non-aqueous medium and with a basic pH.₇

~~----- (in such a way that it is thus possible to substantially reduce, at the output of the filter, the level of polycyclic aromatic hydrocarbons as compared with nicotine, notably by more than 90%, while preserving the nicotine level and the taste aromas for the satisfaction and pleasure of the smoker).~~

5. (Amended) The filter according to claim 4, such that the molecules are formed as a polymer, ~~in the broad sense.~~

6. (Amended) The filter according to ~~any of claims 4 or 5~~, such that the active ingredient exclusively consists of said molecules ~~and/or said polymers~~.

7. (Amended) The ~~eigarette~~ filter according to ~~any of claims 4 to 6~~, such that the mass of said nitrogen-containing cycles or heterocycles, ~~and particularly nitrogen-containing heteroarematic cycles,~~ is at least equal to or larger than 1% of the total mass of the filter.

8. (Amended) The ~~eigarette~~ filter according to ~~any of claims 4 to 7~~, such that the moisture content of the filter lies between 5 and 10%.

9. (Amended) The ~~eigarette~~ filter according to ~~any of claims 4 to 8~~, such that the pH of the filter is larger than 8.

10. (Amended) The ~~eigarette~~ filter according to ~~any of claims 4 to 9~~, such that the molecule of the active ingredient is selected from the group consisting of DNA, and/or RNA and/or a DNA or RNA derivatives thereof. ~~such as for example, adenosine triphosphate (ATP), cyclic adenosine monophosphate or adenylecyclase,~~
~~(in such a way that the carcinogenic toxic products contained in tobacco smoke, affecting the DNA and/or RNA molecules of the human cell, are scavenged by the filter according to molecular processes comparable to those according to which said toxic products act on DNA and/or RNA of the human cell).~~

_____ amine NH_2 ,

_____ketone, aldehyde,

_____methyl,

—alkene, alkyl, and/or aryl.

~~— is added to the molecule of the active ingredient,
on at least one of the nitrogen-containing cycles or
nitrogen-containing heterocycles, and particularly the
nitrogen-containing heteroaromatic cycles.~~

12. (Amended) The filter according to ~~any of~~ claims 4 to 11, such that one or more sugars, ~~such as ribose or deoxyribose,~~ are added to at least one molecule of the active ingredient.

13. (Amended) The filter according to ~~any of claims 4 to 12,~~ such that one or more acid functions and at least, ~~notably pentavalent phosphoric acid (H_3PO_4) and/or another molecule including~~ a trivalent phosphorus atom are added to at least one molecule of the active ingredient.

14. (Amended) The filter according to any of claims 4 to 13, such that polymerization is performed in the broad sense at the nitrogen-containing cycles, i.e.

~~nitrogen-containing heterocycles and particularly nitrogen-containing heteroaromatic cycles and/or added functions and/or acids and/or sugars.~~

15. (Amended) The filter according to ~~any of claims 4 to 14~~, such that the molecule of the active ingredient includes a halogen in a form of one or more atoms, and/or one or more molecules, and/or one or more radicals, or and/or one or more ions of a halogen, such as notably fluorine.

16. (Amended) The filter according to ~~any of claims 4 to 15~~, such that the molecule of the active ingredient is ~~in a halogen salt medium, notably includes~~ a sodium fluoride (NaF) salt medium.

17. (Amended) The filter according to ~~any of claims 4 to 16~~, such that said fibers are partly halogenated, ~~such as notably by fluorine and/or are in a medium including atoms, molecules, radicals or ions of a halogen, such as notably fluorine.~~

18. (Amended) A method for manufacturing a filter including an active ingredient consisting of molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles, said active ingredient being selected from the group consisting of a chain of said molecules and said molecules bound to a fiber in a common chemical arrangement; the mass of said nitrogen-containing cycles or heterocycles being at least equal to or larger than 0.1% of the total mass

of the filter; said nitrogen-containing cycles or heterocycles operating in a substantially non-aqueous medium and with a basic pH including molecules and/or fibers according to any of claims 4 to 17, said method comprising the step consisting of
 -___extruding and/or rolling together said molecules and said fibers.

Claim 19 is cancelled.

20. (Amended) The ~~filtration device~~filter according to claim ~~19~~4, such that said molecules and/or said fibers are incorporated in separate compartments.

21. (Amended) The ~~filtration device~~filter according to any of claim ~~4 to 19~~4, such that said molecules and/or said fibers exist in a gelatinous, liquid or gaseous physical state.

Claims 22 and 23 are cancelled.

ABSTRACT OF THE DISCLOSURE

The method concerns a method for general use and more particularly used for tobacco products. The method uses in particular nitrogen-containing heterocycles such as DNA and RNA bases and complementarily polymer fibers. Said molecules and said fibers can partly halogenated, or in halogenated salt media. The halogen is preferably fluorine. Fluorine may be added to may be in the form of a medium of fluorinated salts such as NaF, KF, $\text{Na}_2\text{PO}_3\text{F}$. The filtering acts against the formation of human intracellular DNA or RNA adducts, while preserving the nicotine and the tobacco aromas.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

-2-

29. A tobacco product including a filtration device that includes an active ingredient consisting of molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles,

said active ingredient is a chain of said molecules, or said molecules bound to a fiber in a common chemical arrangement, or both;

the mass of said nitrogen-containing cycles or heterocycles being at least equal to or larger than 0.1% of the total mass of the filter; and

said nitrogen-containing cycles or heterocycles operating in a substantially non-aqueous medium and with a basic pH.

REMARKS

By the present amendment, claims 13 and 16 are amended and new claim 29 is added. Claims 1-12, 14, 15, 17, 18, 20, 21 and 24-28 are unchanged. Original claims 19, 22 and 23 remain cancelled, although new claim 29 is based on former claim 23. Entry of the amendment is respectfully solicited. A Fee Calculation sheet and our check in the amount of \$51 (Small Entity Status established by the Transmittal letter filed March 12, 2002) is attached.

The Director is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 23-1123.

Respectfully submitted,

WESTMAN, CHAMPLIN & KELLY, P.A.

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RMA:tas

MARKED-UP VERSION OF REPLACEMENT CLAIMS

Claims 1-13 are unchanged.

13. (Twice Amended) The filter according to claim 4, such that one or more acid functions ~~and at least a trivalent phosphorus atom~~ are added to at least one molecule of the active ingredient.

Claims 14-15 are unchanged.

16. (Twice Amended) The filter according to claim 4, such that the ~~molecule of the active ingredient~~ includes a ~~sodium fluoride~~ (NaF) halogen salt medium.

Claims 17-18 are unchanged.

Claim 19 is cancelled.

Claims 20-21 are unchanged.

Claims 22-23 are cancelled.

Claims 24-28 are unchanged.

Claim 29 is new.

1/pts

FILTRATION METHOD AND FILTER CONSISTING OF NITROGEN-
CONTAINING CYCLES OR HETEROCYCLES SUCH AS DNA OR RNA
NOTABLY FOR FILTERING TOBACCO SMOKE AND A CIGARETTE
INCLUDING SUCH A FILTER

The present invention relates to a filtration method and to a filter of general use, notably applicable to tobacco products, and notably for the filter stub of a cigarette. More specifically, the object of the invention is to protect molecules
5 of the human genome against carcinogenic toxic substances from the inhaled smoke.

Cigarette filters known today generally contain polysaccharide derivatives, either of natural origin or thermoplastic, polyesters, such as polyethylene and
10 polypropylene terephthalate. Patents EP 434332 and EP 434339 of RJ. Reynolds Tobacco Cie describe such filters, they may also contain dried tobacco grains. The use of salts, acids, bases, surfactants in a medium with a basic pH, is mentioned in these various patents.

15 More specifically against carcinogenic substances, patent WO 96/00019 describes a cigarette filter enriched with Fe^{++} , Cu^{++} or Mg^{++} ions. The purpose is to retain free radicals and especially protect metalloproteins.

Patent WO 96/10929 describes an inhibitor of free radicals, such as an O-alkylated derivative of 2,4-monofurfurylidene sorbitol, associated with an antioxidant, the action of which is to filter polycyclic aromatic hydrocarbons (PAH), mainly 3,4-benzo-(a)-pyrene (BaP) with known carcinogenic potency.

Moreover, it is known that fluorine has antitumoral effects. Notably, it is involved in the composition of dexamethasone and 5-fluorouracil. Further, the use of laboratory polytetrafluoroethylene (PTFE) filter paper is known.

The filtration method according to the invention has a selective, direct chemical, anti-carcinogenic action. It is intended to filter toxic products, in particular polycyclic aromatic hydrocarbons (PAH) such as benzo-(a)-pyrene (BaP) and nitrosamines, contained in the tobacco smoke of a cigarette.

The filtration method comprises the step for controlling the level of toxic products as compared with that of nicotine in such a way that the reduction in level at the output of the filter is larger than a predetermined threshold. Thus, nicotine and taste aromas are preserved for the satisfaction and pleasure of smokers.

The selective action mode of the method according to the invention, as regards carcinogenic toxic products as compared with nicotine, is one of its main properties.

Its second main feature is its direct chemical action. That is its action towards carcinogenic toxic products at the actual reactive site of DNA.

Preferably, in order to control the level of toxic products, notably the level of polycyclic aromatic hydrocarbons (PAH) and nitrosamines, as compared with that of nicotine, the method according to the invention comprises the following steps:

- the step for scavenging all or part of the toxic products by means of an active ingredient acting on said toxic products according to molecular processes comparable to those according to which human cell DNA and/or RNA reacts
5 towards said toxic products,

- the step for controlling the operating conditions of the filter by operating in a substantially non-aqueous medium with a basic pH, preferably larger than or equal to 8,

- the step for adjusting the mass of the active ingredient
10 so that it is larger than or equal to 0.1% of the mass of the cigarette filter and preferably larger than or equal to 1% of the mass of the filter.

Attacks against DNA and/or RNA molecules of the human cell are chiefly the cause of cancer tumors. Therefore, by
15 filtering the tobacco smoke with molecular mechanisms of the same nature as those which degrade DNA and/or RNA, carcinogenic toxic products contained in tobacco smoke are scavenged both selectively and directly.

The inventors have established that with the minimum
20 amounts of active ingredient and under the aforementioned operating conditions, it is possible to control the level of toxic products, notably the level of polycyclic aromatic hydrocarbons (PAH) and nitrosamines, as compared with that of nicotine.

25 Preferably, said active ingredient consists of molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles, preferably nitrogen-containing heteroaromatic cycles, notably pentacycles or hexacycles or a combination of both. Advantageously, according to the
30 invention, said active ingredient should exist as:

- a chain of said molecules and/or
- said molecules in a common chemical arrangement, bound to a fiber such as a fiber consisting of cellulose acetate.

Preferably, the molecule of the active ingredient is DNA
35 and/or RNA and/or a DNA or RNA derivative, as for example

adenosine triphosphate (ATP), cyclic adenosine monophosphate (AMP), adenylcyclase.

The invention also relates to a cigarette filter implementing the method described above. The cigarette filter according to the invention has selective, direct chemical, anti-carcinogenic action. In particular, it is intended for filtering polycyclic aromatic hydrocarbons (PAH) and notably benzo(a)pyrene (BaP) as well as nitrosamines, while preserving the level of nicotine and the aromas of taste for the satisfaction and pleasure of smokers. The filter includes an active ingredient consisting of molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles and particularly nitrogen-containing heteroaromatic cycles, notably pentacycles, or hexacycles or a combination of both. Advantageously, said active ingredient should exist as a chain of said molecules and/or said molecules bound to a fiber, notably a cellulose acetate fiber, in a common chemical arrangement. The mass of said nitrogen-containing cycles or heterocycles, in particular of the nitrogen-containing heteroaromatic cycles, is at least equal to or larger than 0.1% of the total mass of the filter. The medium in which operate said nitrogen-containing cycles or heterocycles and in particular nitrogen-containing heteroaromatic cycles, is a substantially non-aqueous medium with a basic pH. Under these operating conditions, it has been established that it is possible to substantially reduce, at the output of the filter, the level of polycyclic aromatic hydrocarbons, as compared to nicotine. The level may further be reduced by more than 90% while preserving the nicotine level and the taste aromas for the satisfaction and pleasure of the smoker. According to an alternative embodiment of the filter, other fibers of natural or artificial origin are also used, mainly aromatic derivatives of ethylene (for example, polyethylene terephthalate), of propylene (for example, polypropylene terephthalate) in a medium of fluorinated salts.

Advantageously, in an alternative embodiment of the invention, the molecules are formed as a polymer, in the broad sense.

Also advantageously, in another alternative embodiment of the invention, the active ingredient exclusively consists of molecules and/or said polymers.

Preferably, the mass of said nitrogen-containing cycles or heterocycles, and in particular nitrogen-containing heteroaromatic cycles, is at least equal to or larger than 1% of the total mass of the filter.

Advantageously, the moisture content of the filter lies between 5 and 10%.

Advantageously, the pH of the filter is larger than 8.

Preferably, the molecule of the active ingredient is DNA and/or RNA and/or a DNA or RNA derivative, such as for example, adenosine triphosphate (ATP), cyclic adenosine monophosphate or adenylcyclase.

Hence, the carcinogenic toxic products, contained in tobacco smoke, directly affecting the DNA and/or RNA molecules of the human cell, are selectively scavenged by the filter according to molecular processes comparable with those according to which said toxic products act on human cell DNA or RNA.

Advantageously, the molecule of the active ingredient is added, onto at least one of the nitrogen-containing cycles or nitrogen-containing heterocycles and in particular of the nitrogen-containing heteroaromatic groups, with at least one function selected from a group comprising the following functions:

- amine NH_2 ,
- ketone, aldehyde,
- methyl,
- alkene, alkyl or aryl.

Advantageously, one or more acid functions, notably
5 from pentavalent phosphoric acid (H_3PO_4) and/or another
molecule including a trivalent phosphorus atom are added to
at least one molecule of the active ingredient.

Advantageously, the molecule of the active ingredient
15 includes one or more atoms and/or one or more molecules
and/or one or more radicals and/or one or more halogen ions
such as notably fluorine.

Advantageously, if said active ingredient exists as a chain of said molecules and/or said molecules bound to a fiber, said fiber is partly halogenated, such as notably with fluorine. Also advantageously in this case, said fiber, whether partly
25 halogenated or not, is in a medium including halogen atoms, molecules, radicals or ions, such as notably fluorine.

The invention also relates to a method for manufacturing a filter including an active ingredient consisting of chains of molecules with the features defined above. Said method comprises the step for extruding and/or rolling together said chains of molecules. If said molecules are bound in a common chemical arrangement to fibers, notably cellulose acetate fibers, said manufacturing method comprises the step for extruding and/or rolling together said fibers.

The invention also relates to a filtering device of general application, including an active ingredient consisting of molecules and/or fibers with the above defined features and operating under the above conditions.

5 Advantageously, the filtering device according to the invention is such that said molecules and/or said fibers are incorporated into separate compartments, or exist as grains and/or filaments.

10 Advantageously, the filtering device according to the invention is such that said molecules and/or said fibers exist in a gelatinous, liquid or gaseous physical state.

15 The filtering device may be applied to selective filtration of toxic products. The filtering device according to the invention may be applied to selective purification of tobacco smoke, in order to preserve the usual levels of nicotine, for the satisfaction of the smoker, and those of tar containing the tobacco aromas, for preserving the taste.

20 The invention also relates to a cigarette including a filtering device such as the one described above. As shown in figure 2, the cigarette according to the invention includes a tobacco rod 2. A filtering device 1 such as the one described above is mounted on one of the ends of the rod 2.

25 The invention protects the molecules from the human genome against the carcinogenic toxic products from the tobacco smoke. Further, in the case of a smoking item, this filter has the particularity of preserving the usual nicotine levels and the tars of the aromas in their entirety. This low cost filter with maximum efficiency may be manufactured conveniently and industrially for the best of the smoker's satisfaction and pleasure by preserving the taste, while
30 considerably alleviating the incurred risks, particularly in the field of bronchopulmonary and cardiovascular pathology.

35 The invention considered here, is for protecting the human genome against the attacks from carcinogenic products, the main process involved in the mechanism of

initiation and promotion of the cancer phenomenon. The invention is less concerned about the indirect processes of cell attacks occurring at molecular level such as the metalloproteins or globulins involved in the immune response
5 system.

In the case of a filter for a smoking item, carcinogenic etiogenesis depends on molecules which are not always originally located in the actual tobacco but which are intermediate pyrolysis derivatives formed along the rod of the
10 cigarette through a cooling passageway up to the filter upon inhalation-suction.

These derivatives, either free radicals or carbocations, are electrophilic.

Henceforth, free radicals and carbocations are better
15 known as genotoxic agents which change the rules for duplication of DNA and/or form adducts with it. They may also be responsible for disorders in the coding by DNA of proteins essential to the life of the cells.

The invention implements molecules with several
20 nucleophilic nuclei which prevent electrophilic attack from these agents. According to the invention, these molecules by their amount present in the filter, filter out the toxic products, which would otherwise be doomed to have carcinogenic action in the body of the smoker either *in situ*, or in the liver of the
25 smoker after a metabolization process.

In the human body, the compounds and radicals to be filtered out form potent adducts with DNA by penetrating the cell nuclei or, for pre-carcinogenic products, after having passed through bio-activating systems of the body, and give
30 rise to mutagenic and carcinogenic processes.

It is known that the carcinogenic process most frequently involves electrophilic atoms in molecules for which transmembrane migration towards the cell nucleus is favored by a medium with positive electrical density.

According to the invention, molecules formed with nucleophilic dipoles, voltage forces, π electron clouds which produce nucleophilic poles for attracting electrophilic compounds and radicals are used for filtering out these
5 genotoxic precursor molecules,.

During the tests, it was established that the components of the molecules of the filter according to the invention, and notably the DNA and RNA nucleotides, form an obstacle to the compounds and radicals to be filtered out, before they even
10 reached the human genetic heritage.

Figure 1 which illustrates the outline of an exemplary molecule according to the invention will now be described. Radicals R1, R2, R3 et R4 are amine, ketone, aldehyde, methyl, alkene, alkyl, aryl, functions, etc.

15 These functions, added to the molecule, may be used for filtering out alkyl or aryl epoxides, ester sulfates, nitrosamines, with direct carcinogenic potency.

These radicals R1, R2, R3 et R4 may also be one or more atoms or a radical of a halogen such as fluorine.

20 As an example, purine or pyrimidine type molecules may be produced as filaments, monocatenary strands obtained by DNA denaturation or as RNA strands, most frequently simple strands.

It is known that DNA or RNA may be obtained by growing
25 microorganisms, by breaking up the nuclei and with a gel electrophoresis method.

The filter may use one or more halogens, preferably fluorine, as an atom, a molecule, a radical or an ion.

When used, fluorine may be added beforehand onto a
30 possible precursor phenyl nucleus for the synthesis of the molecule according to the invention, via an inorganic acid, a Brönsted acid, or a Lewis acid.

In the case of a halogenation, the "polymer fever" or "influenza-like" syndrome will be avoided by proceeding with
35 partial halogenation of the fibers.

The halogen salts used are preferably soluble salts of alkaline and alkaline earth metals, for example sodium fluoride.

5 The molecules according to the invention and/or the other fibers of the filter may be extruded or rolled together with the halogen salts, as for example in the manufacturing method described in Patent WO/24078 of Caredent Ltd.

10 Certain toxic products should be excluded, like carboxylic acids of fluorine or their precursors, in particular fluoroacetic acid as well certain dangerous organophosphorus compounds.

The halogen level used shall not exceed the threshold imposed by steps for restricting biodegradation and consumable fluorine level.

15 In the case of a halogenation, the filter may also have a distribution with a high fluorine content for the fibers of the molecules according to the invention and/or for the other fibers of the filter, and then with a lesser fluorine content from the middle towards the periphery of the filter or vice versa, or in distinct compartments positioned along the length
20 of the filter.

The filter, as described here, has the function of filtering out electrophilic compounds and radicals more efficiently, such as polycyclic aromatic hydrocarbons (PAH) - and
25 especially BaP - and nitrosamines.

The filter also includes in certain alternative embodiments, surface-active solvents or other materials (inorganic or carboxylic type acids, bases or salts in particular for maintaining a certain basic pH).

30 The molecules of the filter according to the invention operate in a basic pH preferably larger than or equal to 8, which facilitates the preservation of the nicotine level as indicated earlier.

35 The acid, base and salt functions may either be added to the molecules according to the invention and/or to the other

fibers of the filter substrate, or be located at their contact. They may also be used for halogenating the molecule of the active ingredient and/or of the other fibers of the filter substrate.

5 Highest cleanliness of the inhaled flux, combined with a clearing action on the tissues, provides a very favorable prognosis as to the limitation of cardiovascular, bronchopulmonary pathology and mutagenic or carcinogenic processes.

10 The filter has a general use for filtering contaminants and toxic products. In the case of filtration for a smoking item, the thereby described filter is not necessarily in contact with the tobacco; it may for example be housed within a cigarette holder.

15 During tests in the case of a smoking item, it was established that a few milligrams of active ingredient added to the mass of the filter in a moist medium matching that of a conventional cigarette filter, i.e. of the order of $7 \pm 2\%$, are sufficient for filtering nearly all the incriminated carcinogenic products in tobacco.

20 Generally, the mass of the nitrogen-containing cycles and nitrogen-containing heterocycles and in particular nitrogen-containing aromatic groups present in the filter accounts for at least 0.1% and preferably, more than 1% of the mass of the
25 total mass of the filter.

Tests performed

The tests were performed under the following conditions.

30 A cigarette filter with standard dimensions, injected with monocatenary filaments of salmon DNA consisting of about a thousand nucleotides, wherein the DNA mass is 10 mg per cigarette filter, the filter is dried before the smoking and dosage tests.

35 Moisture content: $7 \pm 2\%$,

pH: about 8

Control cigarettes used: Peter Stuyvesant™, both normal and "extra light".

5 Cigarettes used with a modified filter: normal Peter Stuyvesant™.

1) Comparison of normal Peter Stuyvesant™, and modified Peter Stuyvesant™ cigarettes

	Normal Peter Stuyvesant™	Normal Peter Stuyvesant™, with modified filter	Δ
Nicotine	0.84 mg	0.91 mg	≡
Tars	11.4 mg	12.5 mg	≡
Benzo(a)pyrene	5.5 ng	1.0 ng	- 82%
B(a)P/nicotine	6.55	1.10	- 83%

10 2) Comparison of "extra light" Peter Stuyvesant™ and modified normal Peter Stuyvesant™ cigarettes

	"Extra light" Peter Stuyvesant™,	Normal Peter Stuyvesant™, with modified filter	
Nicotine	0.31 mg	0.91 mg	
Tars	3.8 mg	12.5 mg	
Benzo(a)pyrene	3.3 ng	1.0 ng	- 67%
B(a)P/nicotine	9.68	1.10	- 89%

Average contents expressed per cigarette.

15 Nicotine and tar measurements according to ISO standards 3402/4387/3308/10315/10362.

20 Benzo(a)pyrene measurements according to article "Marine D.C.; Tuck D.J.; Frost B.E.; benzo(a)pyrene analysis in main stream cigarette smoke, CORESTA meeting Hamburg 1999, abstr. ST3". Benzo(a)pyrene contents have been rounded to 0.5 ng/cigarette.

Example of filters according to the inventionExample 1

Conventional cellulose acetate cigarette filter of about
5 200 mg. The filter is injected with salmon monocatenary DNA
strands, with a length of about 2000 base pairs and with an
amount equal to 10 mg for a current cigarette filter.

In a salt medium with 0,1% NaF.

Moisture content: $7 \pm 2\%$,

10 pH: about 8

Example 2

Conventional cellulose acetate cigarette filter of about
200 mg. The filter on its axis consists of a mixed compartment
15 with salmon DNA filaments and polypropylene terephthalate
fibers and a compartment consisting of the latter fibers
exclusively. The mass of the DNA filaments represents 10 mg
for a current cigarette filter.

In a salt medium with 0,1% NaF.

20 Moisture content: $7 \pm 2\%$,

pH: about 8

Example 3

Conventional cellulose acetate cigarette filter of about
25 200 mg. The cigarette filter consists of a mixture of salmon
DNA linear filaments entangled with polypropylene
terephthalate fibers. The mass of DNA filaments represents 10
mg for a current cigarette filter.

In a fluorine salt medium with 0.1% KF, NaF, $\text{Na}_2\text{PO}_3\text{F}$ in a
30 ratio of 1:1:1.

Moisture content: $7 \pm 2\%$,

pH: about 8

CLAIMS

1. A selective, direct chemical, anti-carcinogenic action filtration method for filtering toxic products, in particular polycyclic aromatic hydrocarbons (PAH) such as benzo(a)pyrene (BaP) and nitrosamines, contained in the tobacco smoke of a cigarette; said method comprising the step for controlling the level of toxic products as compared with that of nicotine in order that the level reduction at the output of the filter is larger than a predetermined threshold,

(so that nicotine and taste aromas are preserved for the satisfaction and pleasure of smokers);

in order to control the toxic product level as compared with that of nicotine, notably the level of polycyclic aromatic hydrocarbons (PAH) and nitrosamines, said method comprises the following steps:

- the step for scavenging all or part of the toxic products by means of an active ingredient acting on said toxic products according to molecular processes comparable to those according to which DNA and/or RNA of the human cell react with regards to said toxic products,

- the step for controlling the operating conditions of the filter by operating in a substantially non-aqueous medium and with a basic pH, preferably larger than or equal to 8,

- the step for adjusting the mass of the active ingredient so that it is larger than or equal to 0.1% of the mass of the

cigarette filter and preferably larger than or equal to 1% of the mass of the filter.

2. The method according to claim 1, such that said active ingredient consists of molecules formed by one or more
5 nitrogen-containing cycles or nitrogen-containing heterocycles and particularly nitrogen-containing heteroaromatic cycles, notably pentacycles or hexacycles or a combination of both; said active ingredient existing as:

- a chain of said molecules and/or
- 10 - said molecules bound in a common chemical arrangement to one fiber, notably a fiber consisting of cellulose acetate.

3. The method according to claim 2, such that the molecule of the active ingredient is DNA and/or RNA and/or a
15 DNA or RNA derivative, such as for example adenosine triphosphate (ATP), cyclic adenosine monophosphate (AMP), adenylcyclase.

4. Cigarette filter with a selective, direct chemical, anti-carcinogenic action, particularly for filtering polycyclic
20 aromatic hydrocarbons (PAH), notably benzo(a)pyrene (BaP), as well as nitrosamines, while preserving the nicotine level and taste aromas for the satisfaction and the pleasure of the smoker;

said filter including an active ingredient consisting of
25 molecules formed by one or more nitrogen-containing cycles or nitrogen-containing heterocycles, and in particular nitrogen-containing heteroaromatic cycles, notably pentacycles or hexacycles or a combination of both; said active ingredient existing as:

- 30 - a chain of said molecules and/or
- said molecules bound to a fiber in a common chemical arrangement, notably a fiber consisting of cellulose acetate;
- the mass of said nitrogen-containing cycles or heterocycles and particularly nitrogen-containing

said nitrogen-containing cycles or heterocycles and particularly nitrogen-containing heteroaromatic cycles
5 operating in a substantially non-aqueous medium and with a basic pH.

5. The filter according to claim 4, such that the molecules are formed as a polymer, in the broad sense.

7. The cigarette filter according to any of claims 4 to 6, such that the mass of said nitrogen-containing cycles or heterocycles, and particularly nitrogen-containing heteroaromatic cycles, is at least equal to or larger than 1% of the total mass of the filter.

25 9. The cigarette filter according to any of claims 4 to 8,
such that the pH of the filter is larger than 8.

(in such a way that the carcinogenic toxic products contained in tobacco smoke, affecting the DNA and/or RNA molecules of the human cell, are scavenged by the filter according to molecular processes comparable to those

according to which said toxic products act on DNA and/or RNA of the human cell).

11. The filter according to any of claims 4 to 10, such that at least one function selected from a group comprising
5 the following functions:

- amine NH_2 ,
- ketone, aldehyde,
- methyl,
- alkene, alkyl, or aryl,

10 is added to the molecule of the active ingredient, on at least one of the nitrogen-containing cycles or nitrogen-containing heterocycles, and particularly the nitrogen-containing heteroaromatic cycles.

12. The filter according to any of claims 4 to 11, such
15 that one or more sugars, such as ribose or deoxyribose, are added to at least one molecule of the active ingredient.

13. The filter according to any of claims 4 to 12, such that one or more acid functions, notably pentavalent phosphoric acid (H_3PO_4) and/or another molecule including a
20 trivalent phosphorus atom are added to at least one molecule of the active ingredient.

14. The filter according to any of claims 4 to 13, such that polymerization is performed in the broad sense at the nitrogen-containing cycles, i.e. nitrogen-containing
25 heterocycles and particularly nitrogen-containing heteroaromatic cycles and/or added functions and/or acids and/or sugars.

15. The filter according to any of claims 4 to 14, such that the molecule of the active ingredient includes one or
30 more atoms and/or one or more molecules and/or one or more radicals and/or one or more ions of a halogen, such as notably fluorine.

16. The filter according to any of claims 4 to 15, such that the molecule of the active ingredient is in a halogen salt
35 medium, notably in a sodium fluoride (NaF) salt medium.

17. The filter according to any of claims 4 to 16, such that said fibers are partly halogenated, such as notably by fluorine and/or are in a medium including atoms, molecules, radicals or ions of a halogen, such as notably fluorine.

5 18. A method for manufacturing a filter including molecules and/or fibers according to any of claims 4 to 17, said method comprising the step consisting of extruding and/or rolling together said molecules and said fibers.

10 19. A filtration device including molecules and/or fibers according to any of claims 4 to 18.

20. The filtration device according to claim 19, such that said molecules and/or said fibers are incorporated in separate compartments.

15 21. The filtration device according to any of claims 19 or 20, such that said molecules and/or said fibers exist in a gelatinous, liquid or gaseous physical state.

22. The application of the filtration device according to any of claims 19 to 21, to the selective filtration of toxic products.

20 23. A cigarette including a filtration device according to any of claims 19 to 21.

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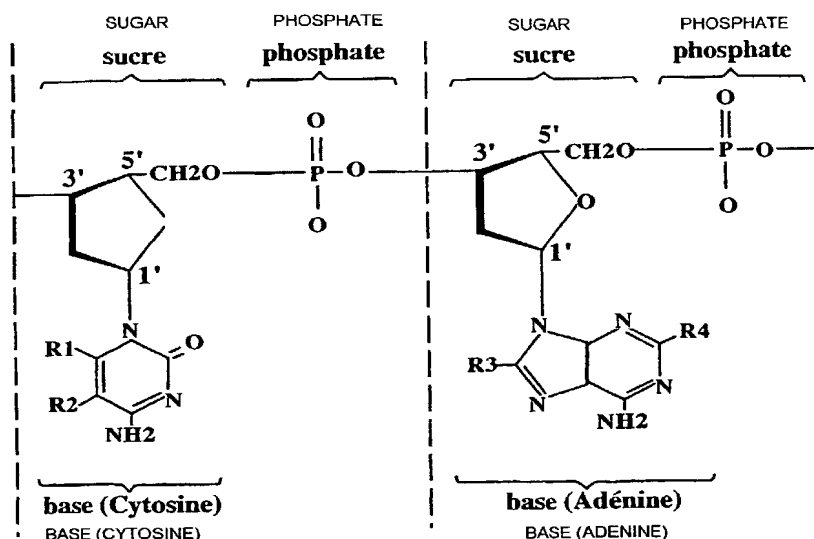
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(54) Title: FILTERING METHOD AND FILTER CONSISTING OF NITROGEN-CONTAINING CYCLES OR HETEROCYCLES
SUCH AS DNA OR RNA DESIGNED IN PARTICULAR FOR FILTERING TOBACCO SMOKE AND CIGARETTE CONTAIN-
ING SUCH A FILTER

(54) Titre: PROCEDE DE FILTRATION ET FILTRE COMPOSE DE CYCLES OU D'HETEROCYCLES AZOTES TELS QUE
L'ADN OU L'ARN DESTINE NOTAMMENT A LA FILTRATION DE FUMEE DE TABAC ET CIGARETTE COMPORTANT
UN TEL FILTRE



(57) Abstract: The method concerns a method for general use and more particularly used for tobacco products. The method uses in particular nitrogen-containing heterocycles such as DNA and RNA bases and complementarily polymer fibres. Said molecules and said fibres can be partly halogenated, or in halogenated salt media. The halogen is preferably fluorine. Fluorine may be added or may be in the form of a medium of fluorinated salts such as NaF, KF, Na2PO3F. The filtering acts against the formation of human intracellular DNA or RNA adducts, while preserving the nicotine and the tobacco aromas.

[Suite sur la page suivante]

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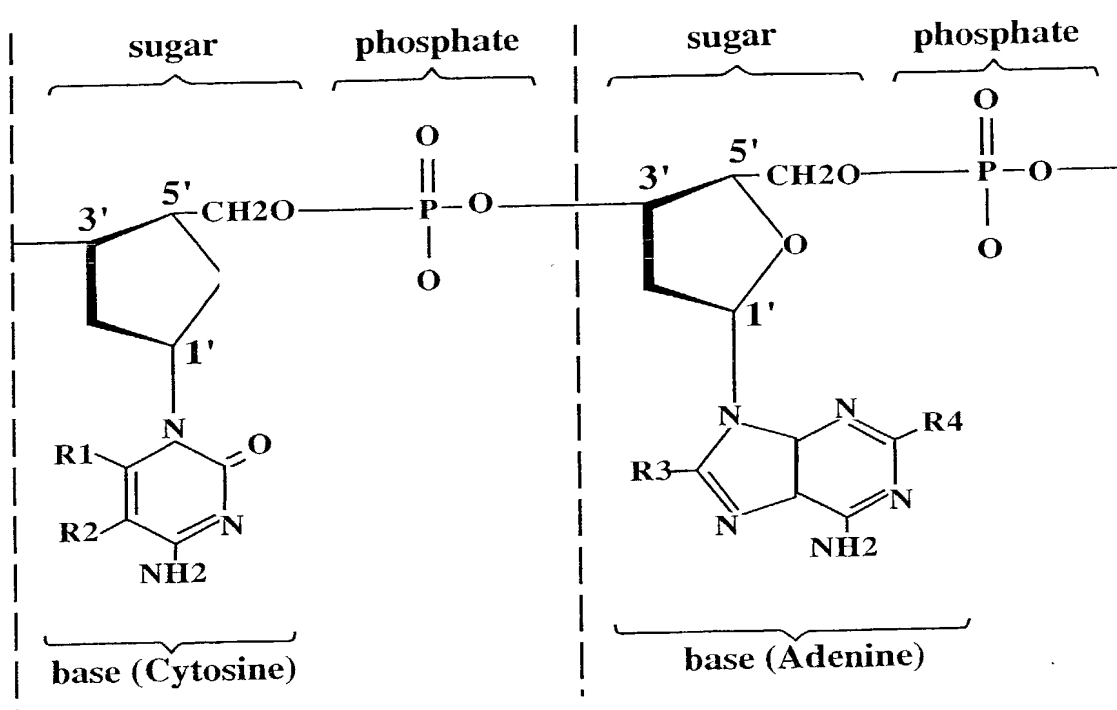


Fig 1

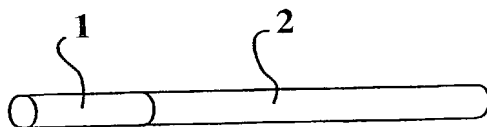


Fig 2

M109.12-0001

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PRIORITY CLAIM (35 U.S.C. § 120)

I claim the benefit under 35 U.S.C. § 120 of any United States application(s) listed below, each of which is incorporated by reference in its entirety. Insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Appln. No.	U.S. Appl. No. (if any under PCT)	Filing Date	Status

DECLARATION

I declare that all statements made herein that are of my own knowledge are true and that all statements that are made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY

I appoint the following attorneys and agents to prosecute the patent application identified above and to transact all business in the Patent and Trademark Office connected therewith, including full power of association, substitution and revocation: Judson K. Champlin, Reg. No. 34,797; Joseph R. Kelly, Reg. No. 34,847; Nickolas E. Westman, Reg. No. 20,147; Steven M. Koehler, Reg. No. 36,188; David D. Brush, Reg. No. 34,557; John D. Veldhuis-Kroeze, Reg. No. 38,354; Deirdre Megley Kvale, Reg. No. 35,612; Theodore M. Magee, Reg. No. 39,758; Christopher R. Christenson, Reg. No. 42,413; Brian D. Kaul, Reg. No. 41,885; Robert M. Angus, Reg. No. 24,383; Christopher L. Holt, Reg. No. 45,844; Alan G. Rego, Reg. No. 45,956; and David C. Bohn, Reg. No. 32,015.

I ratify all prior actions taken by Westman, Champlin & Kelly, P.A. or the attorneys and agents mentioned above in connection with the prosecution of the above-mentioned patent application.

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